

REMARKS

Reconsideration of the rejection of the subject matter of this application is requested.

Claim 5 has been amended to make clearer the fact that the core of the drawn fiber is circular, and to provide limitations that specify that the optical fiber is a multi-mode optical fiber. Both of these features are significant for reasons given below.

Claim 14 has been amended to overcome the rejection under 35 U.S.C. 112.

The drawing

The drawing on file appears to be acceptable.

Status of claims

Claims 1-4 stand withdrawn from consideration. Claims 5-14, and new claims 15 and 16, remain for consideration on their merits.

Summary of invention

Prior to addressing the rejections of record, the most salient features of applicants' invention will be reviewed. First, applicants' invention applies to multi-mode fiber. The phenomena of dispersion affect both multi-mode fibers and single-mode fibers, but in different ways. In single-mode fiber the problem typically addressed is polarization mode dispersion (PMD). In multi-mode fiber the dispersion problem is differential mode delay or DMD. Since there are many more modes and mode groups present in multimode fiber, the problems relating to mode dispersion are different than

those in single-mode fibers. Thus, solutions that address problems in single-mode fibers are typically inapplicable to, or at least different from, those that address problems with multi-mode fibers.

In the prior art, twisting has been applied to single-mode fiber to address PMD. Those methods are represented by the references cited and relied on by the Examiner. In all cases in the prior art, the twist during draw is applied to an optical fiber preform in which the core of the drawn optical fiber is misshaped, typically, oval shaped. The misshaped core of the optical fiber is due to a defective preform. A defective preform, in this context, is a preform where the core of the preform is not circular. For a period of time, oval shaped preforms were discarded as fatally defective. It was then discovered (prior art) that ovality in the preform could be overcome if the optical fiber was twisted during draw. This resulted in an optical fiber that still had an oval core, but the oval core was twisted along the length of the optical fiber so that on average, over a length of the optical fiber, the core behaved as if it were circular.

Applicants' invention is significantly different in at least two major respects from the prior art work involving twisting.

In a later development, shown in the DiGiovanni et al. patent, it was discovered that the problem of DMD in multi-mode fibers could be addressed by twisting. This was a new and novel discovery. It involved also the recognition that an oval core could actually be advantageous, and the optical fiber was deliberately made with an oval core, and twisted during draw to produce a twisted oval core. So in this work it was found advantageous to produce a deliberate twist in the core of the optical fiber, then apply a twist to the fiber during draw. In every case in the prior art, the optical fiber that

is exposed to the twisting treatment has a misshaped or oval core.

In the present application, the inventors discovered that twisting produces effective optical transmission characteristics even when the core of the optical fiber is presumably free of defects, i.e. is circular. That is entirely unexpected and is not taught in the prior art. Moreover, it clearly is unobvious to apply a corrective treatment (twisting) to an optical fiber preform that is free of the defect that the treatment is designed to overcome.

Issues

Rejections

Turning to the rejection based on prior art, the following rejections are acknowledged and intended to be responded to in these remarks.

Claims 5, 6 and 9 stand rejected under 35 U.S.C. 102 (b) as anticipated by the patent to Onishi et al.

Claims 5, 6 and 9 stand rejected under 35 U.S.C. 102 (e) as anticipated by the patent of DiGiovanni et al., or alternatively under 35 U.S.C. 102(a) as anticipated by the DiGiovanni Japanese application.

Claims 7, 8, and 10-14 stand rejected under 35 U.S.C. 103 (a) as unpatentable over the patent of DiGiovanni et al. in view of Henderson et al., or alternatively over the DiGiovanni Japanese application in view of Henderson et al.

As a threshold matter, the status of the DiGiovanni references will be discussed. As the Examiner appears to recognize, the DiGiovanni et al. patent is commonly owned

with the present application, and thus is not prior art with respect to this application. Evidently, for this reason, the Examiner relies on the DiGiovanni Japanese publication, which corresponds to the US application (patent). As discussed above, and will be discussed in more detail below, it is believed that the present application of DiGiovanni et al. claims subject matter that is independently patentable over the prior DiGiovanni application. That being the case, applicants wish to pursue that basis for patentability. However, applicants wish to make it clear that in making this argument for patentability, no admission of prior art status for the Japanese publication is to be implied or inferred. Applicants' make the arguments herein without prejudice to their right in the future, should the need arise, to file the necessary papers under 35 U.S.C. 131 to remove the Japanese reference.

Arguments

Patentability of claims 5, 6 and 9 as anticipated by the patent to Onishi et al. under 35 U.S.C. 102 (b)

With the amendments made to the independent claim, claim 5, it should be even clearer than before that the Onishi et al. patent is not applicable under 35 U.S.C. 102 (b). The rejection will be discussed as if it were under 35 U.S.C. 103.

As described earlier, the problems of dispersion in single mode fibers are different from those in multi-mode fibers. Onishi et al. deal only with single-mode fibers. It is not obvious that techniques for reducing PMD in single-mode fibers can be applied with any benefits to DMD problems in multi-mode fibers. Moreover, the twisting treatment of Onishi et al. is designed to apply to optical fibers with defective cores, i.e.

with cores that are not circular. Applicants' discovery that twisting can be applied to advantage to optical fibers with circular cores is believed to add to the unobviousness of applicants' claims.

Patentability of claims 5, 6 and 9 as anticipated by the patent of DiGiovanni et al. under 35 U.S.C. 102 (e), or alternatively as anticipated by the DiGiovanni Japanese application under 35 U.S.C. 102(a).

The DiGiovanni patent is dealt with above. The DiGiovanni Japanese publication describes work of DiGiovanni et al. in which optical fiber preforms are deliberately made non-circular, so that the core of the optical fibers drawn from these preforms is also not circular. As outlined above, DiGiovanni et al. recognized that the DMD in multi-mode fibers could be addressed by making the optical fiber core oval in shape, then twisting the optical fiber to reduce the adverse DMD effects of the oval, untwisted core. As of the date of the DiGiovanni patent application on which the later Japanese reference is based, DiGiovanni et al. had not disclosed that twisting had any advantageous effect whatever on optical fibers with circular cores. The state of the art on filing of the present application was that twisting was a method applied to oval or distorted cores. If the core is circular, not only is there no need for treatment, but twisting was not known to have any effect at all on an optical fiber with a circular core. A clearer case for non-obviousness can hardly be envisioned.

Patentability of claims 7, 8, and 10-14 over the patent of DiGiovanni et al. in view of Henderson et al., or alternatively over the DiGiovanni Japanese application in view of Henderson et al., under 35 U.S.C. 103 (a).


The applicability of the DiGiovanni et al. references are treated above. The

patent of Henderson et al. is added to the rejection to anticipate certain features of dependent claims 7, 8, and 10-14. The Henderson et al. reference is similar to the Onishi et al. patent in the respect that it addresses problems in single-mode fibers. The Henderson et al. patent is an alleged improvement over the Hart et al. patent. These patents represent the state of the art, as described above, of treating dispersion problems that are specific to single-mode fibers. In both cases those problems involve non-circular cores in single-mode fibers.

In view of these arguments, it is submitted that the application is in condition for allowance and such action is requested.

In the event that the Examiner concludes that a telephone call would advance the prosecution of this application, the Examiner is invited and encouraged to call the undersigned attorney at Area Code 757-258-9018.

Respectfully,


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